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Space systems — Unmanned spacecraft operational procedures — Documentation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and nongovernmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard **ISO /WD 23041** was prepared by Technical Committee ISO/TC 20, Aircraft and Space Vehicles, Subcommittee SC 14, Space Systems and Operations.

Introduction

This international standard prescribes a standard means to facilitate the sharing and exchange of beneficial information among organizations; the spacecraft manufacturer, the mission equipment supplier, the customer or the spacecraft operation center, and the involvement with space operations and support. The international standard provides a common interface to simplify space operations planning and reduce the effort needed to learn and deal with new space programs and support organizations.

Space systems — Unmanned spacecraft operational procedures — Documentation

1 Scope

This international standard establishes standards, current guidelines, and uniform procedures to minimize duplication of effort between the customer, the agency, participating foreign nations, and the emerging commercial space community. This standard standardize the development of space operations and support documentation should facilitate the sharing and exchange of beneficial information between organizations involved with space operations. This international standard establishes a common interface to simplify space operations planning and reduce the effort needed to learn and deal with new space programs and support organizations.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEEE 200, *Electrical & Electronics Parts and Equipment Reference Designations for (With Correction Sheet)*

IEEE-STD-315 (1975), *IEEE Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters) Bound With 315A-1996 (R1993) Supplement to IEEE STD 315-1986*

3 Terms and definitions

For the purpose of this International Standard, the following terms and definitions shall apply.

3.1

operations crew members

personnel who will be using the operations manual to support space systems

3.2

operations agency

organization to which the operations crew members belong

3.3

owner agency

owner of the space system who sets policy for its use

3.4

acquiring agency

organization that is managing the development and acquisition contracts for the space system and understands the engineering and technical aspects of the system's operation

3.5

contractor

organization that is building the system under contract to the acquiring agency

For a particular space system, one organization may be more than one of these agencies.

4 Symbols (and abbreviated terms)

none

5 Documentation

5.1 General Preparations

Unless otherwise specified, the technical manuals and checklists should include either a reproducible copy, film negatives, or a digital format specified by the acquiring agency. If the magnitude of the information to be included in the manual is such that a single volume is not practical, then more than one volume may be used to provide the material.

5.1.1 Arrangement of Material

A main table of contents should be prepared. A subsidiary chapter table of contents should be included at the beginning of each chapter. The chapter table of contents should include the page on which each section, primary paragraph, or major subject headings within that chapter are located.

When a classified manual is involved, the same principles established for the treatment of the main table of contents should be followed. The main table of contents should contain numbers and titles of chapters with their initial page numbers but should not contain any classified information.

Space operations manuals are normally unclassified. If the space system classification guide identifies subjects that are required to be known by space systems crew members as classified, a separate classified manual or a classified supplement to the basic manual will be developed for those classified subjects in accordance with current classification standards.

The heading of the first or introductory paragraph of each chapter should be general in nature to facilitate including information concerning the main subject. Subordinate paragraph headings should be definitive and identify the principal item to be covered.

Wherever practical, text should be simplified and decreased in quantity by the use of complementary art work. All technical matter should be written so it is understandable by all personnel who are expected to use the manual.

5.1.2 Illustrations

The operations manual should contain the following illustrations:

- a. A general arrangement illustration depicting the space system configuration,
- b. Illustrations to clearly show the layout of the space operations center,
- c. Sufficient other illustrations and diagrams to show the major panels, cabinets, consoles, and related equipment that the space operations crew personnel will use for operations,
- d. Sufficient diagrams, charts, and schematics to depict the function, control, and interrelationship of significant space system equipment,
- e. Abbreviations, symbols, reference designations and color coding references used in the space operations manual should be in accordance with IEEE-STD-315 and IEEE 200 unless otherwise specified in this international standard.

5.2 Space Operations Manual

The space operations manual provides a general description of the space system, the operations plan, mission, contingency, and emergency procedural instructions directly associated with and required for normal duty shifts, system status monitoring, alarm anomaly response, mission execution, and postmission operations. The

information should be in sufficient detail to enable a space operations crew member to perform his or her crew duties effectively and safely. The space system should be covered to the extent specified by the operations agency based upon operational system requirements. The manual should be arranged in the standard sequence given in Figure 1.

5.2.1 Overview

5.2.1.1 Front Material

Front material should include those items as listed for this section in Figure 1. The title page, main table of contents, and safety summary should be similar to the format of this recommended practice with details for preparation up to the discretion of the acquiring agency.

The foreword should discuss the various aspects of the operations manual. Such discussion should include the scope of the manual, an indication of the technical proficiency expected of space operations crew personnel, a discussion of format and content, and special interest items, e.g., new developments and a brief description of notes, cautions, and warnings.

5.2.1.2 Requirements for Chapters

The specific requirements of each chapter are covered in detail in the following paragraphs. The listed chapters are mandatory in each manual and additional chapters may be added if required. If a chapter is not applicable, the title of that chapter should be located on the last page of the previous chapter along with a notation that the chapter is not applicable or that information will be added when it becomes available. The title of the chapter should appear in the main table of contents with an appropriate notation.

As appropriate, each chapter should have separate sections for information pertaining to satellite support during launch and early orbit, the operational period, the period when the satellite is no longer fully operational but is still on orbit, and for the satellite end-of-life process.

Format for presentation of the text, amplified procedures, and abbreviated checklist should be at the discretion of the acquiring agency. Format should present crew procedures in a simple, concise and understandable layout, consistent with space system requirements. For systems using digitized technical data, the visual template and the text should be formatted so the screen presentation will be identical to the printed data.

If the operations agency does not require a printed page of the visual display, the visual display should be formatted to comply with the style and format of a printed page. Each page of the emergency procedures chapter should have a border of black diagonal hash markings bled to all four edges of the page. Where possible, amplified procedures and checklists developed for a particular space system should be standardized.

Front Material

- *Cover/Title Page*
- *List of Effective Pages*
- *Verification Status Sheets*
- *Table of Contents*
- *List of illustrations*
- *List of Tables*
- *Foreword*
- *Safety Summary*

Chapter 1 Space System Description

Chapter 2 Space System Operating Functions

Chapter 3 Mission Operating Procedures

Chapter 4 System Contingency Procedures

Chapter 5 Operating Limitations

Chapter 6 Emergency Procedures

Chapter 7 Crew Duties and Responsibilities

Chapter 8 Vocabulary

Figure 1 – Standard sequence for space operations manuals

5.2.2 Space System Description (Chapter 1 of Manual)

Chapter 1 should consist of a system description designed for general orientation. The narrative should describe the purpose, main features, and leading particulars for the space system.

The system and supporting facilities should be described in sufficient detail to provide a single source document of general system information. Illustrations that clarify a particular system or reduce the verbiage necessary for explanation should be included. This chapter can be divided into three sections: satellite segment description, ground segment description, and launch segment description.

5.2.2.1 Satellite Segment

A description of the satellite segment with reference to the structure, attitude control, environmental control, command and control, power, and payload should be included. Subsequent paragraphs should describe in greater detail subsystems peculiar to that satellite segment. Such information should include a general discussion of satellite segment operations to include a description of major subsystems. The description should be of sufficient detail to provide an understanding of the purpose and function of the subsystems, their relation to overall system operations, and such additional information as to enable the crew member to understand subsystem functions peculiar to the overall system. Highly complex satellite segments may require a standalone satellite segment operations manual. Illustrations should be used to simplify explanation of system interrelation and component function. For each of the satellite segment subsystems, depending on the volume of telemetry and commanding material provided, the information may be included in separate appendices or handbooks as appropriate.

5.2.2.1.1 Structure Subsystem

Information should include a description of the structural component with dimensions and particular data concerning component locations plus location of other subsystems, if necessary, to afford a better understanding of satellite construction.

5.2.2.1.2 Attitude and Orbit Control Subsystem

Information should include a brief description of the purpose and type of attitude control and a more detailed description of the components and their respective functions. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.1.3 Thermal Control Subsystem

Information should include a description of the environmental control systems, type of controls employed, and sufficient detail on operations and configuration of environmental control components to provide an understanding of system operations. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.1.4 Tracking Telemetry and Command Subsystem

Information should include a description of the telemetry command and control systems, type of command groups, descriptions of individual command sequences, telemetry, and sufficient detail on operations and configuration of command and control components to provide an understanding of system operations. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.1.5 Power Subsystem

Information should include a description of the power system, distribution system, storage system, power control, and sufficient detail on operations and configuration of power system components to provide an understanding of system operations. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.1.6 Payload Subsystem

Information should include a description of the payload system, mission sensors, data formatting, data recording, and data playback control processors. Sufficient detail on operations and configuration of payload system components should be furnished in order to provide an understanding of system operations. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.2 Ground Segment

A general description of the physical layout, including location and function of mission data processing, data archive, telemetry data processing, radar subsystems, ground sensors, recorder subsystems, security, personnel access, and power systems, should be included. Detailed discussion should include the data processor, data storage, telemetry processor, data switching, external interfaces, antenna/array, transmitter, receiver, and associated support equipment required for system configuration as they support space operations crew member operations. Highly complex ground systems may require a standalone ground system operations manual. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.2.1 Electrical Power Subsystem

A discussion of the electrical power system should include normal, standby, emergency, and uninterruptable power sources, with a description of distribution components, switch gear, and power-generating equipment.

5.2.2.2.2 Environmental Control Subsystem

A description of the environmental control system for the space operations center and equipment areas should be included. The description should also include a general description of heating and ventilating equipment and associated maintenance support equipment including a description of equipment interface with alarm and detector equipment.

5.2.2.2.3 Auxiliary Equipment

General principles of operations should be provided for equipment that requires operator knowledge such as fire detection / suppression, environmental sensing, and security detection.

5.2.2.2.4 Communications

A description of the communications systems will include, but not be limited to, higher authority, command and control, secure/nonsecure voice, secure/nonsecure data, multiplexing/ demultiplexing systems, intersite, intercom, and administrative communications systems. Any crew activity regarding normal, emergency, or malfunction operations will be addressed in the applicable chapter. Highly complex communications systems may require a standalone communications system operations manual. Illustrations should be used to simplify explanation of system interrelation and component function.

5.2.2.3 Launch Segment

Provide in this section information consistent with what operations personnel need to know for the type of launch phase support to be provided. If launch phase support is to be provided, include an overview of the launch sequence plus telemetry, boost phase programmed events, and other launch phase items as appropriate. Also, if information needed by operations personnel and provided in the preceding Satellite Segment and Ground Segment sections is different during the launch phase, identify those differences in this section as appropriate.

5.2.3 Space System Operating Functions (Chapter 2 of Manual)

Chapter 2 should emphasize the process required to bring the system to full operational capability, status monitoring, alarm/anomaly response, mission planning, mission execution, and post-mission activity.

Chapter 2 should contain a functional explanation of the mission, contingency, and emergency procedures contained in other chapters of the manual. Flow diagrams should be presented to support text when it is determined necessary. The functional description should include the following, as applicable:

- a. When the procedure will be accomplished,
- b. Where the procedure will be accomplished; for example, rack, console, or other location,
- c. The time usually required for the system to complete a function,
- d. What is accomplished by the procedure,
- e. Procedure peculiarities, if any,
- f. When it is possible (or prohibited) to accomplish the procedure,
- g. Identification of the crew interface and actions required to operate the function.

Where possible, crew procedures common to all space systems, e.g., complex entry and exit, crew changeover briefings, activity coordination briefing, should be identified by common titles. Amplified procedures should tell who, what, when, where, why, and how. Most procedures in this chapter and in the next chapter will be in checklist format.

5.2.3.1 Operations Center Security Procedures

Amplified procedures should include functions accomplished by the oncoming and duty crew necessary for personnel identification, classified inventory, check of warning devices (if applicable), and specified equipment, as applicable to the space system.

5.2.3.2 Changeover Procedures

Crew changeover procedures and briefings should be included to facilitate the assumption of duties by the oncoming crew. These procedures should include briefings and procedures that will enable both the duty crew and the relief crew to review, examine, and determine system status during the course of changeover. Procedures and briefings that would materially assist in accomplishing an effective crew changeover should be included.

5.2.3.3 Status and Fault Monitoring

Space system status received at the space operations center may be presented by console indications, printouts, and alarms. For abnormal indications, the operator should be given instructions on the best method of prioritizing crew actions and reacting to the indications. Instructions must provide clear direction for the space operations crew member to understand and react to these stimuli and to be able to perform normal, emergency, and malfunction procedures to isolate the condition and maintain maximum space system capability.

5.2.3.4 Activity Coordination Procedures

These procedures should include information required by space operations crew members to accomplish their duty assignments. Information should advise space operations crew members of scheduled activities, operational and maintenance support tasks, emergency procedures, and administrative matters. An activity coordination briefing should be conducted prior to any operations of system equipment or the accomplishment of any onsite maintenance or servicing task. The purpose of an activity coordination briefing is to ensure that safe and correct procedures are followed during the performance of any function involving onsite equipment. It is the responsibility of the briefing official to ensure personnel are thoroughly briefed on all aspects of the activity to be conducted. This briefing should include, but not be restricted to, communications and normal, malfunction, emergency, and contingency procedures in progress or anticipated.

5.2.3.5 Safety Procedures

Procedures for an onsite safety briefing for visiting personnel should be included. The procedures should include information sufficient in scope to advise visiting personnel of existing site hazards, alert procedures, hazardous operations scheduled or in progress, and danger areas. The procedures should include the escort/visitor relationship, location of safety equipment, reaction to announced emergency conditions, and communications procedures.

5.2.3.6 Operations Center Inspections and System Test Procedures

This procedure should provide the space operations crew during alert with a verification of system capability and system status. The extent and complexity of these procedures should depend on the particular space system. In each case, the amplified procedures in this chapter and applicable corresponding abbreviated checklist should contain complete verification procedures for determining system capability and system status. System test procedures are designed to augment the verification of system status and enhance the ability of the space operations crew member to isolate problems and restore the space system to full operational posture. These procedures should be placed in an abbreviated checklist if deemed necessary by the acquiring agency.

Verification/inspection procedures performed by other than space operations crew members should be included in the operations manual.

Equipment status verified by crew personnel during the verification / inspection should include mission-essential equipment. Verification / inspection procedures for equipment requiring status verification less frequently should be contained in other space system technical orders.

5.2.3.7 Communications Equipment Procedures

Activities required to inspect, startup, initialize, and operate equipment and to perform diagnostic tests will be described. Procedures for isolating communications equipment from space system equipment may be required. Either the operations agency or the acquiring agency may request a standalone operations manual for complex or highly integrated communications equipment.

5.2.3.8 Ground System Procedures

Activities required to inspect, startup, initialize, configure, and operate equipment and to perform diagnostic tests will be described. Procedures for isolating ground system from communications equipment may be required. Either the operations agency or the acquiring agency may request a standalone operations manual for complex or highly integrated ground systems.

5.2.3.9 Mission Planning Procedures

These procedures should include the necessary actions to be accomplished by the space operations crew to perform long- and short-term mission planning necessary to accomplish all mission requirements. Amplified procedures and the applicable corresponding abbreviated checklist should contain sufficient detail to ensure all aspects of mission planning are accomplished.

5.2.3.10 Mission Execution Procedures

These procedures should contain mission execution requirements to be accomplished by space operations crew personnel. Procedures should be in sufficient detail to direct space operations crew personnel in accomplishing mission execution of space assets. Operating procedures to identify and correct system anomalies may be required.

5.2.3.11 Post-Mission Procedures

These procedures should contain post-mission requirements to be accomplished by space operations crew personnel. Procedures should be in sufficient detail to direct space operations crew personnel in accomplishing shutdown and reporting procedures (if applicable to the space system).

5.2.4 Mission Operating Procedures (Chapter 3 of Manual)

Chapter 3 should contain detailed information required by the space operations crew in the performance of normal operational duties. It should include briefings and procedures to be conducted during normal duty shift, mission planning, mission execution, post mission, training operations, mission verification and such other operations as may be applicable or specifically required by the acquiring, operations, or owner agency.

Chapter 3 should consist of normal operational briefings and procedures required of space operations crew personnel during the course of a duty shift. The procedures should identify requirements from the point of crew arrival onsite, during daily or recurring tasks, and until crew departure following completion of the duty shift.

Operational procedures should define individual and crew responsibilities and provide amplified procedures sufficient to ensure complete, accurate, and timely accomplishment of these functions. Simple procedures, such as operations center security, should be contained in this chapter. Complex or lengthy procedures should be explained in this chapter in amplified procedures format.

The contents of Chapter 3 should include those crew briefings and procedures required to determine system status, maintain operational capability, execute mission, conduct post-mission operations, and ensure secure operations.

5.2.5 System Contingency Procedures (Chapter 4 of Manual)

Chapter 4 should consist of procedures that will enable a space operations crew to identify and isolate the most probable system malfunctions that could occur during mission operations. These procedures should include trouble shooting guidelines for internal and external problems (solar flares, interference, etc.). In those systems that have redundant or backup equipment, the required procedures to maintain operational status of the system should be provided. At the direction of the acquiring agency, remedial actions should be given in this chapter. For ease of reference, malfunctions should be listed by subsystem and in order of impact on space operations or sustaining operational mission status for the space system.

Chapter 4 should contain information for identification, isolation, and correction of system malfunctions that occur. Space operations crew procedures should be located in this chapter. The information should be of sufficient scope to include corrective procedures for abnormal conditions (induced by internal and/or external conditions), and should be in sufficient detail to enable crew personnel to accomplish appropriate procedures using authorized technical data or under the direction of competent technical authority (i.e., system engineers, command post, etc.). Malfunction identification procedures should be developed to afford ready reference to a particular malfunctioning system and the malfunction indication within that system. The procedures should be as direct and simple as possible, consistent with the action necessary to remedy the malfunction. The information should indicate the effect of the malfunction on the system, probable cause, and corrective action. Presentation of malfunction analysis procedures should be standardized within a space system insofar as possible.

5.2.6 Operating Limitations (Chapter 5 of Manual)

Chapter 5 should contain those limitations that impose a restriction, affect system accuracy, or otherwise adversely affect system operations or system capability.

Chapter 5 should contain operating limitations imposed as a result of system configuration, operational consideration, and environmental restrictions as applicable. It should include a description of each specific limitation and its application to the space system. In discussing limitations, applicable tables and graphs should be included. Operational limitations of a classified nature should be included in a classified supplement to the operations manual.

5.2.7 Emergency Procedures (Chapter 6 of Manual)

Chapter 6 should describe the procedures to be followed in meeting emergencies that might reasonably occur. These procedures should be limited to those emergency conditions, personnel actions, and safety factors that could reasonably reduce the possibility of personnel injury or safety rule violations. This chapter should include required crew reactions to correct or contain emergency conditions or prohibit crew actions in accordance with established directives. Safety hazards, emergency operational procedures, and emergency situations should be clearly defined to ensure crew recognition of an emergency condition occurring during any phase of space operations.

This chapter should be limited to those space operations crew emergency procedures necessary to ensure safe recovery in the event of a critical malfunction or emergency condition occurring during mission operations. If appropriate, procedures should include information prohibiting certain crew actions which, if accomplished, would violate established space system safety directives. Sufficient narrative should be included to enable crew members to recognize a hazardous condition and take appropriate action.

This chapter should include procedures designed for: (1) crew identification of emergency conditions; (2) corrective action; and (3) emergency operations procedures. Additional safety information may be included but should be restricted to items of personnel safety (i.e., high voltages, high pressures, and environmental hazards) but should not include items of a purely first aid nature.

Textual material, amplified procedures, and an abbreviated checklist for emergencies that the crew normally may be expected to encounter during duty shifts or maintenance activity should be included. The amplified procedures should include sufficient textual material to define the immediate effect the emergency condition will have on system capability and such actions within crew capability to restore mission effectiveness. This chapter should include procedures, as applicable to the space system, for use during a fire or overheat situation, hazard situation, security system violations, or space system safety violations.

5.2.8 Crew Duties and Responsibilities (Chapter 7 of Manual)

This chapter should describe those crew positions and duties required to operate space systems. The title, duties, and responsibilities of individual space operations crew positions required to operate the space system safely and effectively during their duty shift and to conduct mission operations should be included. This chapter should be composed entirely of information furnished by the operations agency and should contain no information for which engineering responsibility could become an issue.

5.2.9 Vocabulary (Chapter 8 of Manual)

Serious consideration should be given to preparing a vocabulary for the operations manual. The contents should be arranged in alphabetical sequence and should include technical terms, definitions, acronyms, and abbreviations. The only information to be provided should be distinctive to the space system under consideration.

5.3 Classified Material

The format and contents of the classified manual should be identical to the unclassified manual that it supports. Arrangement and presentation of data should be in accordance with the applicable requirements established for the corresponding unclassified manual, plus such additional requirements as determined by the acquiring agency. A foreword should be included covering the scope and content of the classified manual.

A Classified manual should be published only when determined absolutely necessary. Both manuals should be completely crossreferenced to one another. The method of referencing should be identical in that the title pages and tables of contents will reference one another.

5.4 Abbreviated Checklists and Step-By-Step Procedures

5.4.1 Abbreviated Checklists

This paragraph applies where separate abbreviated checklists are specified by the acquiring or operations agency. The abbreviated operations checklists for use with space operations systems should be prepared jointly by the contractor and the owner and /or operations agency under the supervision of the acquiring agency. Verification of checklist procedures should be accomplished prior to final publication. Unless authorized, preliminary procedures should not be published to support operational requirements of the owner agency. Checklists should contain only that information necessary to safely and effectively accomplish the required tasks. The checklist should tell only what to do and when to do it, not how to do the work. An abbreviated operations checklist should be prepared when one or more of the following conditions exist:

- a. Communication between individuals is necessary to control or monitor task progression,
- b. Potential damage or degradation to equipment is possible that would reduce operational readiness or adversely affect mission capability,
- c. Potential injury to personnel may occur unless prescribed procedures are followed,
- d. The task is critical to mission accomplishment.

Checklist data should include instructions that duplicate, in abbreviated form, corresponding actions contained in the amplified procedures. The data should be presented in step-by-step format and should be limited to material necessary to accomplish the action. The data should be in triple column format: crew duty position(s) performing the step in the first column; step number in the second column; and actions to be performed in the third column. Placard information and response should be printed in upper case letters or figures (e.g., COMMUNICATIONS LINK OUT.) Step-by-step presentation need not consist of complete sentences. Leaders, i.e., SATELLITE CONTROL CONSOLE, should be inserted between columns on the left side of the page.

Reference to applicable operations or maintenance manual(s) chapter and paragraph required to correct a malfunction or continue a mission operation should be listed immediately following the task. Inclusion of such additional data should be limited to information essential to accomplishing the tasks and should be included only when absolutely necessary.

Reverse side of checklist pages intentionally left blank should not contain a statement to that effect. Numbers of the blank pages should appear on the preceding page immediately following that page number and separated by a slash (/). For example: 317/318, 318 being the blank page.

When page numbering continuity is broken by deletion of pages by change, the page deletions should be referenced in the list of effective pages. A statement indicating the deletions should be placed in the bottom margin of the preceding page or the top margin of the following page to show reason for the break in page number continuity. The statement should be in the following form: "All data on Page XX, deleted." When changes to a function within the emergency procedures checklist result in addition or deletion of steps within the function, the entire function should be reissued to avoid any break in sequential page or step numbering and to prevent any pages or major portions of any page within the function from being blank.

Acquiring agencies should ensure that inclusion of special notices be held to an absolute minimum consistent with procedural requirements. When included, warnings, cautions, and notes should precede the action to which they refer.

5.4.2 Step-by-Step Procedures

In lieu of separate abbreviated checklists step-by-step procedures for use by space operations crews should be prepared for lengthy or critical procedures or both. The contractor and the owner and/or operations agency should jointly determine which procedures are step-by-step. Step-by-step procedures should contain only that information necessary to accomplish the required task safely and effectively. The step-by-step procedures should have the following characteristics:

- a. Each step-by-step procedure should start at the top of a page,
- b. Step-by-step procedure titles should be identified at the top and bottom of each page,
- c. All illustrations should be located at the rear of the chapter or section to which they apply,
- d. Narrative procedures should be placed in the front of the appropriate chapters, and the step-by-step procedures should be arranged sequentially,
- e. Each step of the procedure should be numbered. There should be no lettered substeps in the step-by-step procedures,
- f. Procedures should be paragraph numbered,
- g. Introductory text (lead-in paragraphs) should not be included in step-by-step procedures but should appear in the appropriate chapter,
- h. Lead-in statements referring to particular items of equipment or alternative actions should be underlined,
- i. Where lead-ins reference nomenclature and steps, the nomenclature should be referenced first, followed by applicable steps,
- j. Amplifications of Steps should be included only when necessary,

- k. Information applying to several steps should be presented as a note or lead sentence as best suits the situation,
- l. The step-by-step procedural step should contain actions to be checked, observed, or verified and arranged in order of performance,
- m. Applicable cautions and warnings pertaining to personnel injury or equipment damage should be included in the procedure,
- n. Verification of step-by-step procedures should be accomplished prior to final publication.

A separate and distinctive checklist should be prepared covering appropriate emergency amplified procedures and mission continuation procedures as contained in Chapter 4. Emergency procedures checklist should be restricted to those crew procedures required to safeguard the equipment, prevent injury to personnel, or continue mission functions involving hazardous conditions or operations. Pages within this checklist should be prepared in the same format as the normal procedures checklist except that they should have a border of black diagonal hash markings bled to all four edges of the page.

EXAMPLE : Step-by-step procedure of Mission Check List (MCL), and SOE are attached in Annex A (informative) as draft.

Annex A

(informative)

Mission Check List (MCL)

A.1 General

This Annex provides procedures used to exchange administrative and technical information in the satellite operation among organizations.

MCL is a standard procedure used to conduct satellite operation in each visible pass between NASA-NASDA, NOAA-NASDA, ESA-NASDA, CNES-NASDA, CEE-NASDA.

A.2 Configuration of MCL

MCL is constructed corresponding to transmission protocol and type of data to be transmitted shown in Examples 1 through 3.

EXAMPLE 1 Step-by-Step Operation Procedure : MCL / X.25

| Timing | From | To | Event ID | Message | Comment |
|-----------------------|------|-----|----------|--|--------------------------------|
| AOS20Min | SOM | ST | 1 | CONFIRM ST is ready to support | |
| | TC | ST | 1A | INFORM ST support requirement in this visible pass | |
| AOS15Min | TC | ST | 2 | SEND 'connection request' from GW to ST for TLM & CMD | X.25 |
| | ST | TC | 2A | ST transmit Test TLM Data | |
| | TC | ST | 2B | CONFIRM receipt at GW | |
| | TC | ST | 2C | SEND SYSTEM ALIVE messages to ST | |
| AOS10Min | ST | | 3 | Terminate transmission of Test TLM data, and Reconfigure for Real time support | U/L,D/L Polarity e.t.c |
| | TC | | 3A | Key in receipt TLM display Console ID at GW | TC in house only |
| | TC | | 3B | Key in CMD transmit Console ID at GW | TC in house only |
| AOS | ST | | 4 | AOS | |
| | TC | | 4A | CONFIRM receipt TLM at GW | |
| | SOM | TC | 4B | ANNOUNCE ST AOS TIME | HH:MM:SS |
| EL greater than 5 DEG | SOM | TC | 5 | REPORT carrier-up and sweep at El greater than 5DEG time | Detect El angle 5 DEG crossing |
| | TC | ST | 5A | CMD transmission for Satellite operation by SOE/SOP | |
| EL smaller than 5 DEG | SOM | TC | 5A | REPORT carrier-down at EL smaller than 5 DEG time | Detect El angle 5 DEG crossing |
| LOS | ST | | 6 | LOS | |
| | SOM | TC | 6A | ANNOUNCE ST LOS TIME | HH:MM:SS |
| | TC | | 6B | Clear ID and release TLM display Console at GW | TC in house only |
| | TC | | 6C | SEND 'connection release' from GW to ST for TLM & CMD | X.25 |
| | TC | SOM | 7 | ANNOUNCE next voice contact DAY & TIME | DD:HH:MM:SS |

EXAMPLE 2 Step-by-Step Operation Procedure : MCL / TCPIP

| Timing | From | To | Event ID | Message | Comment |
|------------------------|------|-----|----------|--|--------------------------------|
| Few hours • •before | TC | ST | 0 | Communication Link connection for the TLM & CMD and check | TCPIP |
| AOS20Min | TC | ST | 1 | CONFIRM ST is ready to support | |
| | TC | ST | 1A | INFORM ST support requirement in this visible pass | |
| AOS15Min | ST | TC | 2 | ST transmit Test TLM Data | |
| | TC | ST | 2A | CONFIRM receipt at GW | |
| | TC | ST | 2B | SEND SYSTEM ALIVE messages to ST | |
| AOS10Min | ST | | 3 | Terminate transmission of Test TLM data, and Reconfigure for real time support | U/L, D/L Polarity e.t.c |
| | TC | | 3A | Key in receipt TLM display Console ID at GW | TC in house only |
| | TC | | 3B | Key in CMD transmit Console ID at GW | TC in house only |
| AOS | ST | | 4 | AOS | |
| | TC | | 4A | CONFIRM receipt TLM at GW | |
| | SOM | TC | 4B | ANNOUNCE ST AOS TIME | HH:MM:SS |
| EL greater than 5 DEG | SOM | TC | 5 | REPORT carrier-up and sweep at El greater than 5 DEG time | Detect El angle 5 DEG crossing |
| | TC | ST | 5A | CMD transmission for Satellite operation by SOE/SOP | |
| El smaller than 5 DEG | SOM | TC | 5B | REPORT carrier-down at EL smaller than 5 DEG time | Detect El angle 5 DEG crossing |
| LOS | ST | | 6 | LOS | |
| | SOM | TC | 6A | ANNOUNCE ST LOS TIME | HH:MM:SS |
| | TC | | 6B | Clear ID and release TLMdisplay Console at GW | TC in house only |
| | TC | SOM | 7 | ANNOUNCE next voice contact DAY & TIME | DD:HH:MM:SS |

Abbreviations for Step-by-Step Operation Procedure

MCL : Mission (Operation) Check List*

AOS : Acquisition of signal

LOS : Loss of signal

ST : Satellite Tracking & control station :Track Satellite, Acquire TLM Data and Transmit CMD
(EXAMPLE : NASA=GDS,CNES= CNESKourou,ESA=Perth)

SOM : Station Operation Manager (EXAMPLE : NASA=JPL,CNES=TLS/Toulouse,ESA=ESOC)

TC : Satellite Tracking & control center : direct ST's

EL : Elevation Angle of Tracking antenna

GW : Gate Way for X.25

JPL : Jet Propulsion Laboratory NASA

GDS : Gold Stone Satellite Tracking & control station JPL/NASA

* MCL is used to conduct Satellite Operation in each Visible Pass

between NASDA and another Agencies (NASA, NOAA, ESA, CNES, CEE)



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EXAMPLE 3 Step-by-Step Operation Procedure : SOE / SOP

| Timing | From | To | Event ID (SOP No.) | Event | Comment |
|-------------|------|----|--------------------|---|------------------------|
| AOS+10 Min | •• | •• | 1(INT101) | 1 St AOS Operation SPACECRAFT(S/C) status check | NASDA only |
| AOS+1.5 h | TC | ST | 2(INT102) | 1 St AOS CMD ESA ON •oh Mode ENA Fuel Tank /Line Heater •• | |
| AOS+2.0 h | TC | ST | 3(INT103) | Solar Array Paddle hold | |
| MNVR1.0 h | TC | ST | 4(INT104) | 20• Thruster•THR•Test Maneuver (MNVR) Catalyst Bed Heater ON Latching Valve Operation | |
| MNVR Time | TC | ST | ••(INT105) | 20• THR Firing | |
| MNVR+20 min | TC | ST | •(INT106) | Solar Array Paddle SLEW & start the •• tracking | |
| LOS40min | TC | ST | •(INT107) | •oh Mode DSA | for next NASDA station |
| •OS30 Min | •• | •• | •(INT108) | Pre LOS Operation S/C status check | NASDA only |

- The Procedure 5A in MCL is replaced by This SOE/SOP •

Abbreviations for Satellite Operation Procedure : SOE

SOE : Sequence of Events

SOP : Satellite operation procedure (The set of CMD sequence and related TLM data variation to be monitored)

INT102 ; INT= Initial Phase (Launch Early Orbit Phase) SOP

NM102 ; NM= Normal Phase SOP

OC102 ; OC=Orbit Control Phase SOP

CTG102 ; CNT=Contingency SOP

EC102 ; EC =Eclipse Phase Operation SOP

1 =Orbital revolution count (countup node)

02 =procedure No